FRACTURES OF THE MANDIBLE
AN URBAN CENTRE STUDY

Dissertation submitted to
THE TAMILNADU Dr. M.G.R. MEDICAL UNIVERSITY
In partial fulfillment of the regulations
for the award of degree of

M.Ch BRANCH - 111
PLASTIC SURGERY

002

INSTITUTE OF RESEARCH AND REHABILITATION OF HAND
AND DEPARTMENT OF PLASTIC SURGERY,
STANLEY MEDICAL COLLEGE AND HOSPITAL
CHENNAI – 600001, TAMIL NADU.

AUGUST 2008

CERTIFICATE

This is to certify that Dr.R. Sridhar, a M.Ch., Postgraduate student of Plastic Surgery, Department of Plastic Surgery and IRRH, Stanley Medical College, Chennai – 600 001, carried out this dissertation titled "FRACTURES OF THE MANDIBLE- AN URBAN CENTRE STUDY", by himself under my guidance and direct supervision during the period of August 2005 to May 2008. This dissertation is submitted to The Tamilnadu Dr.M.G.R. Medical University, Chennai in partial fulfillment of the award of M.Ch. Degree in Plastic Surgery.

PROF.T.C. CHANDRAN
Head of the Department,
Department of Plastic surgery and IRRH,
Stanley Medical College,
Chennai-600 001.

DEAN
Stanley Medical College,
Chennai-600 001.

ACKNOWLEDGEMENT

I place on my records my thanks to **Dr.T.Venkatakrishnan,M.D.,** DEAN, STANLEY MEDICAL COLLEGE AND HOSPITAL, for allowing me to do this study.

I am greatly indebted to **Prof. T.C. Chandran**, M.S.,M.Ch., Head of the Department, Department of Plastic Surgery and IRRH, who with his vast knowledge and experience, provided valuable guidance, continuous help and constant support in every stage throughout the study and has contributed enormously in making this study possible.

I also thank Prof. R. Krishnamoorthy,M.S.M.Ch., for his expert advice and guidance.

I thank all the Assistant Professors of the Department, Dr.J. MOHAN, Dr. J.JAGAN MOHAN, Dr.N.C.HARIHARAN, Dr.G. KARTHIKEYAN, Dr. M.SUGUMAR, Dr.G.S. RADHAKRISHNAN, Dr.P. THANGAVELU Dr. P. NELLAIAPPAR and Dr. M. RAJKUMAR for their suggestions, encouragement and support throughout my course.

I would like to thank my co-residents for their unstinted help in preparing this dissertation.

Finally I would like to thank all the patients in this study for their co-operation without whom, this study would not have seen the light of the day.

CONTENTS

INTRODUCTION

The mandible is reportedly the most common fractured bone in facial trauma. The injury is found predominantly in males in the 25 to 34 year old age group.

HISTORY

A. Ancient Egypt: The Edwin Smith Treatise

Written approximately 3000 B.C. in hieroglyphics, but "carpetbagged" by American Edwin Smith in approximately 1862, who bought it off an Egyptian peasant for mere trinkets. "If thou examinist a man having a fracture in his mandible, thou shouldst place thy hand upon it... and find that fracture crepitating under thy fingers, thou shouldst say concerning him: One having a fracture in his mandible, over which a wound has been inflicted, thou will a fever gain from it. An ailment not to be treated." Cause of death was assumed to be sepsis.

B. **Ancient Greece- Hippocrates**

Written in 460 B.C. The first description of closed reduction with inter-dental wiring! . "Displaced but incomplete fractures of the mandible where continuity of the bone is preserved should be reduced by pressing the lingual surface with the fingers while counter pressure is applied from the outside. Following the reduction, teeth adjacent to the fracture are fastened to one another using gold wire."

C. "Modern" Europe

The first European medical school, in Salerno, Italy, was established in 1180 AD. "(for mandibular fractures)...take olibaisum, mastic, colophene, glue and dragon blood; all this must be mixed with liquefied resin until it becomes ointment, which is placed over (the fracture)..."

D. America - Thomas Gunning

A dentist during the civil war, during which time the therapy of mandibular fractures was greatly advanced. Designed the "Gunning splint" in 1984 for William Seward, the Secretary of State to Abraham Lincoln, who suffered bilateral body fractures after falling out of a carriage. The splint was a single piece of vulcanite with a space for eating. Screws were used to stabilize the splint to the hard palate and the mandible. Gunning declared Mr. Seward cured after several months of therapy. His assessment and methods were highly controversial, however, and most considered his treatment unsatisfactory.

E. America - "Mr. Thomas"

Apparently a ship's carpenter who fancied himself a scientist. Pioneered open reduction with internal fixation in 1869 after a friend was struck by a piece of timber aboard ship. He writes: "There was great mobility of the fractured part. My assistant kept him steady with a piece of wood directed across his face whilst I drilled a hole through the jaw. A strong silver wire was passed through ... and drawn tight, making the fracture firm. The site was

tightened every four days. In four weeks it was sufficiently secure to allow the wire to be removed and the jaw used."

AETIOLOGY

- Road Traffic Accidents
- Inter-personal violence
- Falls
- Sporting injuries
- Industrial trauma
- Missile injuries
- Gunshot wounds
- Pathological fractures

The primary causes of mandible fractures are vehicular accidents and assaults. These vary according to the geographic, socioeconomic status and ethnic status of community. Other significant causes are falls and sporting injuries. In a large retrospective study of 2137 patients with mandible fractures, Ellis et al reported 43% were caused by vehicular accidents, 34% were by assaults, 7% occurred as a result of fall, 7% were work related, 4% were by sporting injuries and reminder has miscellaneous causes.

CLASSIFICATION

According to

A. TYPE OF FRACTURE

- SIMPLE OR CLOSED : fractures that do not produce wound open to the external, whether it be through skin, mucosa or periodontal membrane
- GREENSTICK:fractures in which one cortex is broken and other bent, found exclusively in children and is a rare variant of simple fracture
- COMPOUND OR OPEN: fractures in which external wound is in communication with the fracture, be it skin mucosa or periodontal membrane
- COMMINUTED :fractures in which bone is splintered or crushed
- PATHOLOGICAL:fractures occurring due to trivial trauma, due to a preexisting bone disease
- MULTIPLE :variety in which there are 2 or more fracture lines which are not communicating with one another
- IMPACTED :fractures in which one fragment is driven firmly into another
- ATROPHIC :fractures resulting from severe bone atrophy, as in edentulous mandible

- COMPLICATED OR COMPLEX :fractures in which considerable injury to adjacent structures occur, whether it is simple or compound

B. SITE OF FRACTURE

- SYMPHYSIS: fracture that runs from alveolar margin to inferior border in the region of central incisors
- PARASYMPHYSEAL :fractures that are occurring within the boundaries of vertical lines distal to canine teeth
- BODY :from the distal symphysis to a line coinciding with the alveolar border of masseter muscle, including the 3rd molar
- ANGLE :triangular region bounded by anterior border of masseter muscle to the postero-superior attachment of masseter
- RAMUS: bounded by superior aspect of angle to 2 lines forming an apex at the sigmoid notch
- CONDYLAR PROCESS: area of the condylar process superior to the ramus region
- CORONOID PROCESS :includes the coronoid process of mandible superior to ramus region
- DENTO-ALVEOLAR : region that normally contains the teeth.

C. CAUSE OF FRACTURE

- DIRECT VIOLENCE
- INDIRECT VIOLENCE
- EXCESSIVE MUSCULAR CONTRACTURE

D. EFFECT OF MUSCLE ATTACHMENTS

The effect of muscle action on the fracture fragments is important in the classification of angle and body fractures. Angle fractures may be classified as

1) **Vertically favourable or unfavourable and**
2) **Horizontally favourable or unfavourable.**

The forces acting on the mandible are an important consideration in mandible fractures. The lateral pterygoid protrudes the jaw and arises from the lateral pterygoid plate and inserts on the condylar neck and the temporomandibular joint capsule. The mylohyoid, digastric, genioglossus, and the geniohyoid all depress and retract the jaw. The mylohyoid arises from the mylohyoid line and inserts into the body of the hyoid. The digastric arises at the mastoid notch and inserts into the digastric fossa. The genioglossus arises from the genial turbercle and fans out to the entire length of the inferior surface of the tongue. The geniohyoid arises from the inferior genial turbercle and inserts into the anterior hyoid bone. The elevators of the jaw include the temporalis, masseter, and medial pterygoid. Inward displacement of the jaw results from the actions of the lateral and medial pterygoid muscles. The masseter arises from the zygoma and inserts into the angle and the ramus. The

temporalis arises from the infratemporal fossa and inserts on the coronoid process and ramus. The medial pterygoid arises from the medial pterygoid plate and the pyramidal process of the palatine bone and inserts on the inner table of the lower mandible.

Favorable fractures are those fractures where muscles tend to draw the fragments together. Ramus fractures are almost always favorable secondary to the elevating forces of the muscles. Unfavorable fractures result when the muscles tend to draw the fragments apart. Most angle fractures are horizontally unfavorable because of the pull of the jaw elevators. Vertically unfavorable fractures of the symphysis and parasymphysis tend to collapse inward in a scissor- like fashion secondary to the jaw depressors especially the mylohyoid.

E. PRESENCE OF TOOTH IN FRACTURE FRAGMENTS

- Class 1 : when one or more teeth is present in both the fragments
- Class 2 : when one or more teeth is present in one fragment
- Class 3 : when both the fragments are without any teeth

CONDYLAR FRACTURES

Condylar fractures are classified as extra-capsular, subcondylar and intra-capsular. The lateral pterygoid tends to cause th medial and anterior displacement of the condylar head.

SURGICAL ANATOMY

The mandible is a U-shaped bone containing thick buccal and lingual cortices and a thin medullary cavity. This bone actually consists of two hemimandibles that unite at the midline symphysis. It is formed by intramembranous ossification. The hemimandibles fuse to form a single bone by 2 years of age. Each side consists of the perpendicular body and the horizontal ramus, which unite at the angle. The upper border of the ramus is capped by the coronoid anteriorly and the condyle posteriorly, separated by the sigmoid notch. The condyle articulates with the glenoid fossa to form the temporomandibular joint, a diarthrodial joint with two motions: rotation around the horizontal axis of the condylar head and forward translation. The joint capsule contains a mobile cartilaginous disc that can be injured or displaced with condylar fractures. The alveolar ridge is the tooth-bearing region of the mandibular body and consists of compact cortical bone.

The blood supply of the mandible is from the inferior alveolar artery and the direct muscular attachments. The inferior alveolar nerve enters the medial mandible at the mandibular foramen with the artery, traverses the medullary cavity near the lingual cortex below the level of the tooth roots, and then rises to exit the mental foramen at about the second premolar. This nerve provides sensation to the mandibular teeth and the skin and mucosa of the lower lip.

Two main groups of muscles insert and act upon the mandible: the

muscles of mastication and the suprahyoid muscles. There are four chief muscles of mastication, innervated by the mandibular branch of the trigeminal nerve. The masseter is a thick, rectangular muscle, originating from the zygomatic arch and inserting on the lower lateral border of the ramus. The temporalis originates from the temporal fossa and inserts on the coronoid and anterior border of the ramus.

The medial pterygoid originates on the medial portion of the lateral pterygoid plate and inserts along the medial border of the angle. These three muscles exhibit a strong upward pull on the posterior mandible and act to close the mouth. The temporalis also retracts the mandible. The lateral pterygoid muscle originates from the lateral aspect of the lateral pterygoid plate and the greater wing of the sphenoid and inserts on the neck of the condyle and the capsule of the temporomandibular joint. This muscle protrudes the mandible and assists in opening the mouth. Alternating actions of the internal and external pterygoid muscles result in side-to-side movement of the mandible. The suprahyoid muscle group includes the digastric, stylohyoid, mylohyoid, and geniohyoid muscles. The digastric muscle has two bellies joined by a central tendon. The posterior belly, innervated by the facial nerve, originates from the mastoid and extends anteriorly and inferiorly. The anterior belly, innervated by the mylohyoid branch of the inferior alveolar nerve, originates on the lingual surface of the parasymphysis and extends inferiorly and posteriorly. The two muscles insert into a common tendon, which perforates the stylohyoid

muscle, and into the greater cornu of the hyoid. The stylohyoid originates from the styloid process and inserts into the body of the hyoid. It is innervated by the facial nerve. The mylohyoid is a broad, flat muscle originating from the mylohyoid line on the lingual surface of the mandible, extending from the symphysis to the third molar. It insets into the body of the hyoid and is innervated by the mylohyoid branch of the inferior alveolar nerve. The geniohyoid originates from the lingual surface of the mandible superior to the mylohyoid and inserts into the body of the hyoid bone. The hypoglossal nerve innervates this muscle. The suprahyoid musculature elevates the hyoid and the base of tongue during swallowing and depresses the mandible, which opens the mouth. Displacement of fracture segments commonly occurs as a result of the differing forces of these muscles acting upon the mandible. In general, the muscles of mastication tend to displace posterior segments superiorly, while the suprahyoid muscles pull the anterior segments inferiorly. In addition, the lateral pterygoid muscles tend to pull the condylar head medially with high condyle fractures.

CHANGES PRODUCED IN THE MANDIBLE BY AGE

AT BIRTH

The body of the bone is a mere shell, containing sockets of two incisors, the canine and two deciduous molar teeth, imperfectly partitioned off fromone another. The mandibular canal is of larger size and runs in the lower border of bone. The mental foramen opens beneath the socket of first deciduous molar tooth. The angle is obtuse (175 degrees), the condyloid portion is nearly in line with the body. The coronoid process is comparatively larger and projects above the level of condyle

CHILDHOOD

Two segments of bone begin to join in symphysis from below upwards, with a trace of separation in the alveolar margin by second year of age. The body becomes elongated in its legth and depth more so behind the mental foramen for accommodating 3 addition teeth developed in this part. The mandibular canal, after second dentition is situated just above the mylohyoid line and mental foramen occupies adult position. Tha angle becomes less obtuse, about 140 degrees by 4^{th} year of age.

ADULT

Alveolar and subdental portions are of equal depth. Mental foramen opens midway between upper and lower border and mandibular canal runs

nearly parallel with mylohyoid line. Ramus is almost vertical and angle measuring 110 to 120 degrees.

OLD AGE

Bone becomes greatly reduced in size and with loss of teeth, the chief part of bone is below oblique line. The mandibular canal and mental foramen is close to the alveolar border. The ramus is oblique and angle measures about 140 degrees and the neck of condyle is bent more or less backwards.

ANATOMY OF THE MANDIBULAR NERVE

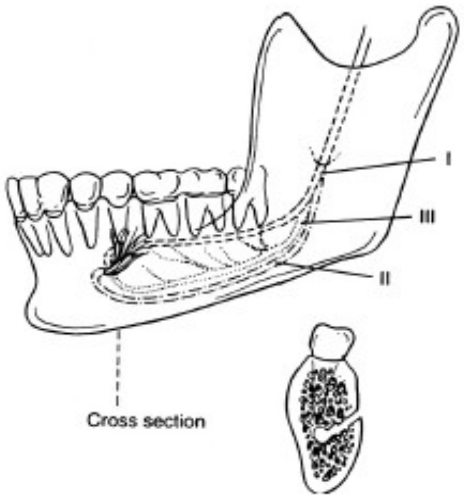
The mandibular nerve is the third and inferior most division of the trigeminal nerve, or the fifth cranial nerve. The trigeminal nerve is predominantly a sensory nerve, innervating most of the face. The lower branch is called the mandibular nerve and innervates the teeth and the mandible, the lateral mucosa of the mandible, and the mucosa and skin of the cheek, lower lip and chin (Scothorne 1976, Gosling *et al.* 1985). The mandibular nerve runs from the trigeminal ganglion through the foramen ovale down towards the mandible. The nerve enters the mandible through the mandibular foramen on the medial surface of the ascending mandibular ramus. Before it enters the bone, the mandibular nerve gives branches to the tongue and to the soft tissues of the cheek. After passing through the mandibular foramen, the nerve is called the inferior alveolar nerve (IAN). The IAN contains mainly sensory fibres and only a few motor fibres distributed by the mylohyoid nerve to the mylohyoid and the anterior belly of the digastric muscles. Within the mandibular canal, the IAN runs forwards in company with the inferior alveolar artery and together they are called the inferior alveolar neurovascular bundle. The IAN supplies the lower molar and premolar teeth and adjacent parts of the gingiva. Its larger terminal branch emerges from the mental foramen as the mental nerve to innervate the skin of the chin and the lower lip, while the smaller incisive branch supplies the canine and incisor teeth. Disturbances of the IAN and

mental nerve will predominantly give sensitivity symptoms in the soft tissue of the lower lip and chin. (Aldskogius *et al.* 1985).

ANATOMICAL VARIATIONS

Different variations in the course of the inferior alveolar neurovascular bundle are described (Anderson & Kosinski 1991). The classification by Carter and Keen (1971) in the mandible is illustrated in Figure. In another larger study the course of the IAN was evaluated from 3612 radiographs (Nortje *et al.* 1977). The radiographs were divided into four categories: 1) high mandibular canals (within 2mm of the apices of the first and second molars), 2) intermediate mandibular canals, 3) low mandibular canals, and 4) other variations – these included duplication or division of the canal, apparent partial or complete absence of the canal or lack of symmetry. Of the 3612 subjects, 47% of the canals were high, 49% were low, and only 3% could not be fitted into the high or low canal categories. The main conclusion of this study was, that the mandibular canals are usually, but not invariably, bilaterally symmetrical, and the majority of hemimandibles contain only one major canal.

Classification of the topography of the inferior alveolar nerve. (I = the nerve has a course near the apices of the teeth, II = the main trunk is low down in the body, III = the main trunk is low down in the body of the mandible with several smaller trunks to the molar teeth, 1V = bifid mandibular canals or absent mandibular canal.(McManners 2000).



The university numbering system for permanent teeth begins with the right third molar of the maxilla to the left third molar of the maxilla(number 16) and then goes to the left third molar of the mandible(number 17) to the right third molar of the mandible(number 32). The 20 deciduous teeth are lettered in a similar fashion from A to T.

OCCLUSION - THE ANGLE CLASSIFICATION

This is based on the relationship of the mesiobuccal cusp of the maxillary first molar to the buccal groove of the mandibular first molar.

a. Class I: normal occlusion

b. Class II: mandibular first molar more anterior. An "underbite" . An overjet of more than 4 mm creates a "buck tooth" appearance.

c. Class III: mandibular first molar more posterior. An "overbite" The incisiors are either edge to edge or with a negative overjet.

COMMON SITES OF FRACTURE

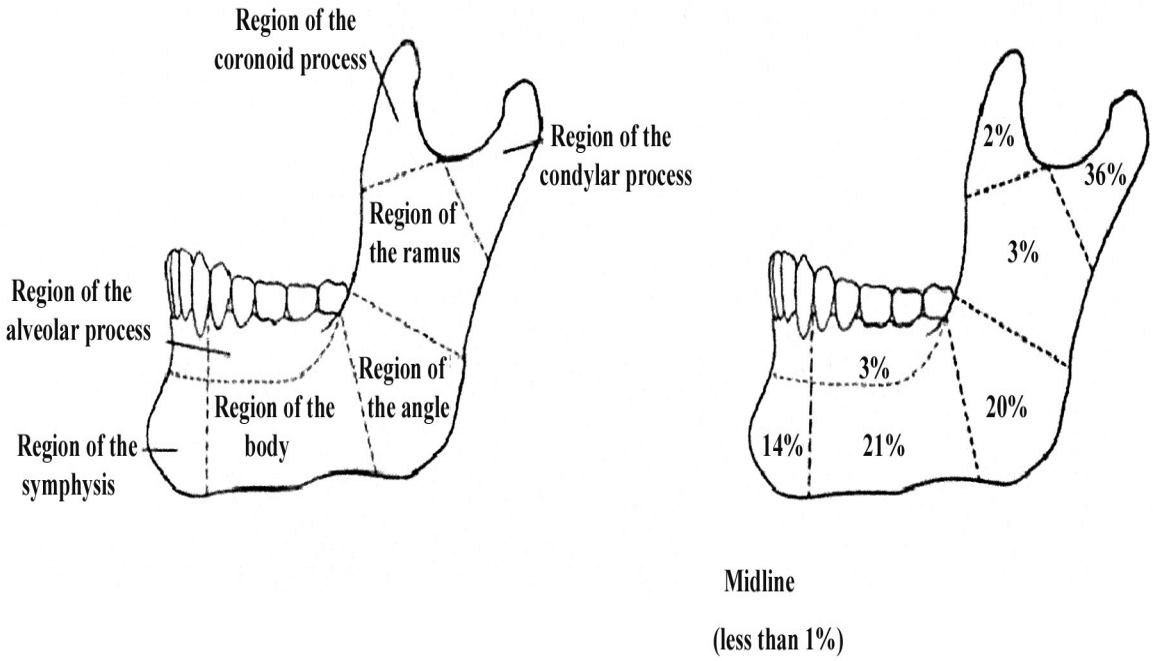
1. Condyle 36%

2. Body 21%

3. Angle 20%

4. Parasymphysis 14%

5. Coronoid, ramus, alveolus, symphysis all less than 3% each. Weak areas include the 3rd molar (particularly when impacted) and the canine fossa



CLINICAL EXAMINATION

A. History

- **1. Pre-existing pathology:**

  a. bone disease

  b. neoplasia

  c. arthritis

  d. collagen vascular diseases

  e. nutrition and metabolic disorders, including alcohol abuse

  f. endocrine disorders

  g. temporomandibular joint disorders. These patients are at risk for ankylosis!

- **2. The type and direction of the force**

  a. motor vehicle accidents tend to have multiple, compound and comminuted fractures

  b. A fist is often a single, non-displaced fracture

  c. An anterior blow to the chin often leads to bilateral condylar fractures

  d. An angled blow to the parasymphysis often leads to contralateral condylar and or angle fractures

e. Clenched teeth lead to alveolar process fractures

B. PHYSICAL EXAMINATION

1. Change in occlusion

a. Any change is occlusion is highly diagnostic of a mandible fracture

b. Posterior premature dental contact or an anterior open bite is suggestive of bilateral condylar or angle fractures

c. Posterior open bite is common with anterior alveolar process or parasymphyseal fractures

d. Unilateral open bite is suggestive of an ipsilateral angle and parasymphseal fracture

e. Retrognathic occlusion is seen with condylar or angle fractures

f. Prognathic occlusion is seen with effusion of the TMJ

2. Anesthesia of the lower lip

a. "Pathognomonic" of a fracture distal to the mandibular foramen

b. The converse is not true: all fractures distal to the mandibular foramen do not cause paresthesias

3. Abnormal mandibular movement

a. Inability to open the mandible suggests impingement of the coronoid process on the zygomatic arch

b. Inability to close the mandible suggests a fracture of the alveolar process, angle, ramus of symphysis, all of which lead to premature posterior dental contact

c. Trismus leading to an inability to open the mouth more than 35 mm is highly suggestive of a mandibular fracture. The lower level of normal is 40 mm

4. Lacerations, Hematomas and Ecchymosis

a. Lacerations: The direction and type or fractures can often be visualized through facial lacerations. If a mandibular fracture is present with a facial laceration, the laceration should not be closed until it is certain the laceration cannot be used to access the fracture.

b. Ecchymosis of the floor of mouth is a diagnostic sign of a body or symphyseal fracture

5. Loose Teeth

a. Multiple fractured teeth that are firm indicates a clenched jaw during the trauma. Think alveolar fracture

6. Palpation

The mandible should be palpated with both hands, with the thumb on the teeth and the fingers on the lower border of the mandible. Slowly and carefully place pressure, noting the characteristic crepitation of a fracture.

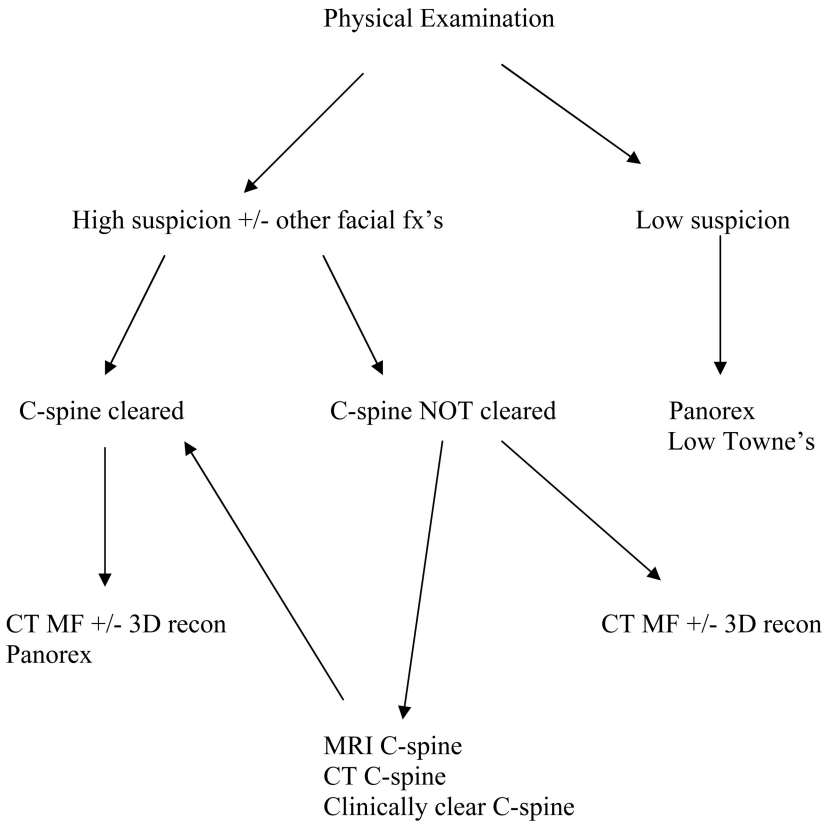
RADIOLOGICAL DIAGNOSIS

The following types of radiographs are helpful in making the diagnosis of mandible fractures.

- Panoramic radiograph
- Lateral oblique radiograph
- Postero-anterior (PA) mandibular view
- Reverse towne view
- Mandibular occlusal view
- Periapical radiographs
- Temporomandibular joint views including radiography
- CT scan with 3D reconstruction

Standard mandibular series should consist of at least a panoramic radiograph, a PA view and a reverse towne view. Traditional lateral oblique radiographs can be taken in severely traumatized patients as panoramic radiographic view requires upright positioning of patient without any motion. Occlusal views are useful for accurate assessment of symphyseal fractures. Periapical radiographs may be used to assess root fractures.

DIAGNOSTIC ALGORITHM



DIAGNOSTIC PROCEDURES

When preinjury occlusion is difficult to determine, use of study models is very helpful as it permits model surgery and hence splints can be fabricated for the new arch form. For fully edentulous patients, dentures or processed acrylic base plates can be used. These are called Gunning splints

PRELIMINARY TREATMENT

1) MAINTENANACE OF AIRWAY: Careful examination of airway and removal of teeth fragments, broken fillings and dentures. In comminuted symphyseal region fractures, there is some danger of tongue falling back and producing airway obstruction, which can be prevented by controlling the tongue using a suture passed through its dorsum. Make the patient lie in lateral position.

2) CONTROL OF HAEMORRHAGE: occasionally serious haemorrhage can occur with facial artery injuries in compound fractures of mandible and requires ligation of vessels

3) TREATMENT OF SOFT TISSUE LACERATIONS: if general condition of patient is not fit ofr primary mandible fracture management, it is desirable to close the soft tissue wounds within 24 hours.

4) SUPPORT OF BONE FRAGMENTS: if urgent immobilization is required, arch bars may be applied till further definitive procedure

5) MANAGEMENT OF LOOSE OR LOST TOOTH: reimplantation of avulsed teeth may be successful if it is done within ½ to 1 hour and is supported firmly with splints.

6) CONTROL OF PAIN

7) CONTROL OF INFECTION: intravenous antibiotics at the time of sugery is recommended and are especially useful in patients undergoing delayed treatment, patients having long operations, patients with severely contused soft tissue, with multiple intra-oral lacerations, patients who are medically compromised and poor oral and dental hygiene.

8) FOOD AND FLUID MANAGEMENT

9) MANAGEMENT OF OTHER INJURIES: Forty to sixty percent of mandible fractures are associated with other injuries. Ten percent of these are lethal. The most common associated injury is to the chest. Cervical spine injury is associated in 2.59% of mandible fractures. Although the incidence of cervical spine injury associated with mandible fractures is low, missing this injury could result in severe neurological sequelae. Motor vehicle accidents are the predominant cause of cervical spine injury in association with mandible fractures. C1 and C2 are most commonly involved. Condylar fractures can rarely be displaced with the fragment herniating through the roof of the glenoid fossa into the floor of the middle cranial fossa which can be associated with a dural tear. If this happens, consultation to neurosurgery should be obtained

TREATMENT OF MANDIBULAR FRACTURES

The treatment of mandible fractures can be divided into open and closed techniques.

CLOSED TECHNIQUE

Closed treatment refers to EXTERNAL FIXATION DEVICES and MANDIBULOMAXILLARY FIXATION (MMF) which is based on the principle that when the teeth of a fractured segment are in correct occlusion, then the bone fragments to which they are attached will, in most cases, also be satisfactorily reduced. Healing of the bone occurs by secondary intention with callus formation in the same way as a long bone in a cast heals. The mandible must be immobilized for 4-6 weeks for most fractures. The average weight loss is 10-15 pounds.

Indications for closed reduction of mandibular fractures remain controversial but may include non displaced or grossly comminuted fracture, , fractures in the presence of mixed dentition or in the atrophic mandible, and fractures of the coronoid or condyle. External fixation and intraoral appliances were once widely used for closed reduction but have now been largely replaced by other methods. Splints and dentures are occasionally used in children with mixed dentition or in edentulous patients. The splints or dentures are fixed to the mandible and maxilla by palatal screws or circumferential wires. Occlusion

is then established and maintained by wiring the upper and lower appliances together.

Closed reduction is commonly achieved by intermaxillary fixation using arch bars, ivy loops, or suspension screws. Arch bars are applied to the upper and lower jaws with circumdental wires. Occlusion can be maintained with either wires or elastics. we prefer to use elastics to provide a constant tension and to guide the teeth into occlusion. Ivy loops are useful in patients with mixed dentition or poor dentition and in patients who are unable to tolerate the application of arch bars, but they are largely of historical interest. Another method of intermaxillary fixation involves placement of anterior suspension screws and wiring. Two screws are placed near the lateral pyriform aperture in the maxilla and two are placed medial to the mental foramen in the mandible, with suspension wiring to bring the teeth into occlusion.

MMF is the primary treatment for condylar and subcondylar fractures. Unilateral condylar fractures with good occlusion can be managed with close observation and liquid diet. MMF for 2 to 3 weeks is recommended for those with continued pain, malocclusion, or bilateral condylar fractures.

Contraindications to MMF: Seizure disorders, psychiatric disorders, compromised pulmonary function, eating or GI disorders, non-compliant, alcoholism, pregnant, with multiple injuries and those who are unwilling to change their lifestyle for 4-6 weeks.

External fixation devices such as Hoffman pins, and the Morris Biphase apparatus are useful for certain cases. The indications include severe traumatic loss of bone, severely atrophic mandibles that prevent the use of plates, fractures complicated by osteomyelitis, infected nonunion, and loss of bone to be repaired with subsequent bone graft or free flap.

OPEN TECHNIQUE

Open techniques of mandible repair are divided into RIGID AND SEMI-RIGID FIXATION.

Wire osteosynthesis is a form of semi-rigid fixation using 0.35mm stainless steel wire to secure the fractured segments. A small amount of movement of the proximal and distal segments occurs causing healing with periosteal callus formation. This technique is useful for superior border wiring.

Indications for open reduction and internal fixation of mandible fractures include most symphyseal and parasymphyseal fractures, displaced body and angle fractures, and certain condylar fractures.

Adequate exposure is a key component of proper open reduction of mandible fractures. An intraoral buccal sulcus incision is commonly used for parasymphyseal and body fractures, with care taken to avoid injury to the mental nerve and its branches. Either an external or an intraoral approach can be used for access to angle and ramus fractures. The external approach can

provide better visualization and access to the inferior border, but the marginal mandibular nerve may be placed at risk. Most plating companies offer specialized cheek retractors that aid in the intraoral approach to the posterior mandible. The fracture site should be adequately debrided of all fibrin and hematoma to allow tight approximation of the bone edges. Reduction can often be achieved with application of intermaxillary fixation. Additional reduction may be achieved with the use of a lower border wiring technique or bone pliers to approximate two fracture fragments. This lower border wire can then be removed once a plate has been placed across the fracture line. There continues to be debate over whether to maintain intermaxillary fixation after open reduction and internal fixation of the mandible.

Indications for use of intermaxillary fixation after open reduction and internal fixation include the presence of a concomitant subcondylar fracture, if a single plate is used without a tension band or when the stability of the internal fixation is in question, such as in comminuted fractures.

A recent review describes the three basic types of rigid fixation: stabilization by compression, stabilization by splinting, and semirigid fixation. The indications for the use of compression plates remain controversial, as the plates are technically difficult to use and may cause malocclusion and there are no studies showing their superiority versus other fixation methods. Compression plating of mandibular fractures may result in higher rates of

complications, especially infections.

Lag screws may be used for compression if the fracture line is favorable and if the fracture is noncomminuted. Usually, two lag screws at least 20 mm in length are sufficient for stabilization. When treating a parasymphyseal fracture, two long lag screws can be criss-crossed across the vertical fracture line. The superior screw must be placed in the buccal cortex to avoid damage to the tooth roots. Lag screws may also be used to repair oblique fractures of the horizontal ramus.

A tension band plate is sometimes placed on the superior border of the fracture line to closely approximate this area, because it tends to separate. This is referred to as the CHAMPY TECHNIQUE. The tension band plate can also be used in the wider section of the vertical mandible. This is sometimes used in body and angle fractures. Care must be taken to avoid the dental roots.

The tension band can be used in combination with a larger bicortical fracture plate or may be used alone, with reliance on the muscles of mastication for fixation.

A locking reconstructing plate can be used when the fragments are small and comminuted and compression is not needed. This method has become more popular over the past few years. Internal fixation is achieved by locking the screw to the plate rather than compressing each fragment of bone to the

plate. One usually places a minimum of four screws in the plate, two on each side of the fracture line. A locking plate may also be used in combination with a dental splint to add additional fixation if the comminution involves alveolar bone. Proponents of the locking plate point out that the placement of screws should not alter the reduction, but this has not been proven. Also, the screw should not loosen secondary to inflammation, infection, or placement in a fracture gap, since it is locked to the plate. It is unproven whether adequate alignment of the fractured mandible can be obtained with an unbent locking plate when treating comminuted mandible fractures or combined parasymphyseal and condylar fractures. These complex fractures make it difficult to obtain adequate arch form when plating them. For instance, if the plate is not contoured to the curve of the mandible when plating a parasymphyseal fracture, then a concomitant subcondylar fracture will be displaced. The treatment of comminuted fractures using AO/ASIF reconstruction plates was reported to have a low complication rate of 3 percent in at least one study.

Semirigid fixation can be performed using a small plate with 1.5- to 2.0-mm unicortical screws. The advantages are the limited periosteal stripping of the fracture site needed. This technique relies on the forces of the strong jaw muscles to “hold” the fracture in place. The minor complication rate is higher and includes plate/screw extrusion and fracture, but the major complication rate is low.

CONDYLAR FRACTURES

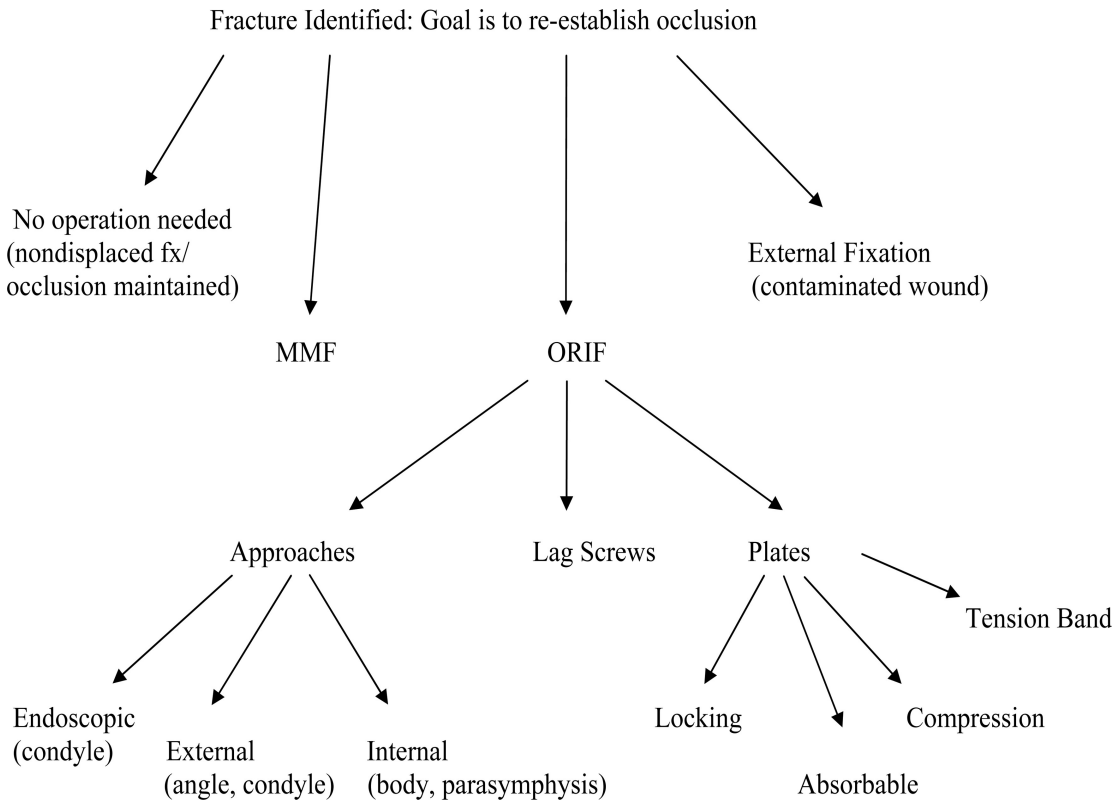
Lindahl Classification System for Mandible Condyle Fractures

Fracture level
Condylar head: at or above the ligamentous attachment
Condylar neck: thin, constricted region below head of condyle
Subcondylar: from the sigmoid notch to the posterior mandible just below the neck of the condyle
Dislocation at fracture level of condylar neck, subcondylar
Angulation with medial override
Angulation with lateral override
Angulation without override
Fissure
Position of condylar head to articular fossa
No displacement
Slight displacement
Moderate displacement
Dislocation

Condylar fractures most often are treated with MMF only. If nondisplaced, this is left in place for 3 weeks followed by elastics for 2 weeks. If displaced, the patient will need 6 weeks of MMF. Absolute indications for

ORIF of condylar fractures include displacement of the fragment into the middle cranial fossa, lack of adequate reduction with MMF, lateral extracapsular displacement of the condyle, and invasion by a foreign body(e.g. a GSW). Relative indications for ORIF of condylar fractures include bilateral condylar fractures in an edentulous patient when splinting is impossible, unilateral or bilateral condylar fractures when splinting is not recommended for medical reasons, bilateral condylar fractures associated with midface fractures, and bilateral condylar fractures with significant pre-injury malocclusion. To avoid ankylosing the TMJ, mobilization needs to be performed every 2 weeks in adult patients and weekly in children. Ramus fractures are usually favorable and can be treated with MMF. Angle fractures are treated with MMF only if favorable. If unfavorable, they need ORIF. Body fractures are treated in a similar manner to angle fractures. Symphyseal or parasymphyseal fractures usually require ORIF and lag screws or compression plates can be used.

TREATMENT ALGORITHM



FRACTURES OF MANDIBLE IN CHILDREN

There are several differences in the treatment of mandible fractures in children. The bone of a child is more elastic and fractures tend to greenstick or minimally displace. There are also many unerupted teeth, which tend to weaken the bone. The mandible of a child is still growing, and any open reduction of fractures can disrupt growth centers, especially of the condyle. Most clinicians advocate treating nondisplaced fractures of the condyle in children by closed reduction combined with some sort of fixation with

mandibulomaxillary fixation and guided elastics. Guided elastics and early mobility help prevent ankylosis at the temporomandibular joint. Rigid mandibulomaxillary fixation should not last for more than 7 to 10 days in a child. If the child has no evidence of malocclusion, one often prescribes a soft diet and analgesics. Nondisplaced angle, body, and parasymphyseal fractures may be treated with closed treatment methods. Displaced mandibular fractures in children are treated in a manner similar to that used for adults, with open reduction and internal fixation as indicated, but absorbable plates should be considered. The role of absorbable plates in the treatment of mandible fractures continues to evolve and has implications in the treatment of the child's growing mandible.

FRACTURES OF EDENTULOUS MANDIBLES

Edentulous patients may undergo closed reduction by wiring the patient's dentures to his jaws using circumandibular and circumzygomatic wires. Screws can also be placed to fixate the dentures into the palate or mandible. If no dentures are available, Gunning splints with an arch bar incorporated into them can be used for closed reduction. To make the splints, an impression is first made. Next, a cast made out of plaster or stone is made from the impression. Then acrylic splints are made with holes for wiring and grooves for circumandibular and circumzygomatic fixation.

MANAGEMENT OF TEETH IN THE LINE OF FRACTURE

Amaratunga in his review of 191 patients with 226 fractures, has used the following criteria for removal of teeth in the line of fracture.

Absolute indications for tooth removal

- Longitudinal fracture involving the root
- Dislocation or subluxation of tooth from its socket
- Presence of peri-apical infection
- Infected fracture line
- Acute pericoronitis

Relative indications for tooth removal

- Functionless tooth which would eventually removed electively
- Advanced caries
- Advanced periodontal disease
- Doubtful teeth which could be added existing dentures
- Teeth involved in untreated fractures presenting more than 3 days after injury

It is desirable that all teeth not covered by these conditions be retained

Management of teeth retained in fracture line

- Good quality intra-oral peri-apical radiograph
- Instituition of appropriate antibiotic therapy

- Splinting of tooth if mobile
- Endodontic therapy if pulp is exposed
- Immediate extraction if fracture becomes infected
- Follow-up for 1 year with endodontic therapy if there is demonstrable loss of vitality

POST-OPERATIVE CARE

This may be divided into three phases

1. Immediate postoperative phase

    - Take care of airway, if required cut MMF and take a tongue stitch or sometimes tracheostomy
    - Prevent vomiting, if it comes nurse in left lateral position

2. Intermediate phase

    - Observe maintenance of reduction and immobilization
    - Most patients find it comfortable in sitting position and nurse so
    - Sedation is contra-indicated as it might compromise respiration
    - Prophylactic antibiotics for compound fractures
    - Effective oral hygiene maintenance
    - Feeding –
        - In conscious cooperative patients, liquid or semi-solid diet
        - In unconscious or uncooperative patients, enteral feeing through nasogastric tube or parenteral therapy

3. Late phase

- Little adjustment of occlusion if required
- Mobilization of temporomandibular joint
- If there is sensory loss, microneural repair of inferior dental and lingual nerve can be done
- Management of teeth and its supporting structures

COMPLICATIONS

1) Early complications

- Haemorrhage : requires drainage if localized and antibiotic cover
- Carotid injury : dislocations can damage carotid artery, resulting in aneurysm or thrombosis with stroke
- Facial nerve injury : fractured fragments of ramus can lacerate or contuse the facial nerve
- Infection : appropriate antibiotics, I&D of any collection, assess security of fixation. If necessary remove hardware
- Avascular necrosis, osteitis and osteomyelitis : soft tissue rest, antibiotics, removal of devitalized bone and soft tissue with appropriate drainage. If necessary, external fixator may be applied

2) Late complications:

- Malunion : for patients who had no treatment, malunion rates are high and require refracturing and bone grafts may be required.
- Delayed and non-union : infection, osteoporosis or nutritional deficiency predisposes to delayed union and may not require intervention in elderly edentulous patient if fibrous union is present. The largest gap that can be expected to heal is 3 mm. Poor position and reduction of fracture, improper immobilization, comminuted fractures with devascularised segments, infections and nutritionally deficient patients develop nonunion and require surgical intervention.
- Temporomandibular joint ankylosis : can occur with condylar or coronoid fractures. Requires excision of fragment and joint reconstruction at a later stage. If malocclusion persists with good range of bmotion, sagital split osteotomy may be used.
- Malocclusion : improper MMF, inadequate final reduction, inadequate plate contouring and failure of adequate fixation can cause malocclusion. May be corrected by grinding the occlusal facets or refracture or osteotomy
- Increased facial width and mandibular rotation : it is aesthetically and functionally unacceptable. Requires refracture and use of long and strong reconstruction plate.
- Implant failure : includes plate and screw head fracture. Titanium was found to produce metalosis and hence the consequences.
- Scars : extra-oral incisions and soft tissue injuries tend to develop hypertrophic scars or keloids in selected individuals and requires appropriate management.

ENDOSCOPIC MANAGEMENT OF FRACTURE MANDIBLE

Endoscope assisted treatment combines the best of open and closed treatment of mandible fractures. It is primarily used for condylar fractures, can be used for symphyseal fractures. It has the potential to reduce the morbidity by limiting scar, reduces risk to facial nerve, eliminates MMF, all the while embracing the advantages of anatomic reduction and rigid fixation. Subcondylar fractures, without comminution, lateral displacement of proximal fragment, non dislocated condylar head and without other major medical illness are ideal candidates for endoscopic management. Under appropriate antibiotic cover, nasotracheal intubation, after achieving reduction, through intra-oral or submandibular approach, using a 4mm 30 degree scope fitted with endoscopic brow sheath, rigid fixation is done with standard 5 or 6 hole 2.0 carnio-facial zygoma dynamic compression plates, using atleast 2 6mm secrews on either side of fracture. Post operative management with soft diet for 6 weeks, peri operative antibiotic therapy and physiotherapy is given. Encouraging results with minimal morbidity has been reported, but good prospective data are not yet available.

AIM OF THE STUDY

1) To record the number of patients with fracture mandible, following trauma, who underwent treatment in the department during study period

2) To study the age and sex group of patients involved

3) To analyse the various causes of injuries that led to the fracture mandible

4) To study the different region/s affected

5) To study the type of inferior alveolar canal in each patient and its implication in management

6) To study the various modalities of treatment applied

7) To study the functional outcome of the treatment

MATERIALS AND METHODS

All patients who reported to the Plastic Surgery Department, Government Stanley Medical College, who were diagnosed as patients with Fracture of Mandible were included in the study.

The study period was from August 2005 to May 2008. The patients were referred from other departments or came directly to Plastic surgery Department.

The methodology adopted consists of recording

1. cause of injury
2. age and sex groups involved
3. region of the mandible affected
4. investigations and treatment planning
5. status of inferior alveolar canal
6. preliminary and comprehensive treatment performed
7. pre-operative and post operative occlusion
8. management of other injuries
9. post operative assessment
10. complications that occurred

All these necessary data were recorded in a proforma.

55 patients of mandibular fractures were registered with the plastic surgery department during the study period.

Detailed history regarding nature of injury and symptoms were obtained. A thorough physical examination was done to assess the general status of patient, assess other major and minor injuries, site and number of fractures of the mandible.

Investigations were done which included X-Ray skull AP/Lateral view, X-Ray mandible PA view and Lateral view, Ortho-pan tomogram, CT-Scan with 3D reconstruction as required.

If indicated and once the patient is fit for surgery, open reduction and internal fixation with Miniplate and screws was done in the majority of patients who underwent surgery. Some patients with good occlusion, associated injuries were managed with maxillo-mandibular fixation for 3 to 4 weeks.

About 20 patients were not operated due to varying reasons like associated life threatening head or chest wall injuries, patients not willing for surgery or who have absconded from treatment.

ANALYSIS AND DISCUSSION

The total number of patients treated during the study period at the plastic surgery department was fifty-five.

Age-wise distribution of mandibular cancers is shown in the following table:

Table 1

Age-wise distribution of Mandibular Fractures

Age group	No. of patients
5-14	3
15-24	12
25-34	24
35-44	8
45-54	4
55-64	3
65-74	0
75-84	1
Total	55

Majority of the patients fall in the 15 to 45 age group forming 80 % of total incidence. The age group 25-34 has the highest incidence 46.3 % in this study. In this study the youngest patient was 7 years old female and the oldest patient was 83 years old male. These results are in comparison to a study by ogundare et al (2003), which shows the highest incidence in 25-34 year age group in urban major trauma center.

Sex-wise distribution of mandibular fractures is shown in the following

table:

Table 2

Sex-wise distribution of Mandibular Fractures

Sex	No. of patients
Male	51
Female	4
Total	55

We found the majority of injuries occurring in young male population.

The following table shows the aetiology of Mandibular Fractures.

Table 3

Aetilogy of Mandibular Fractures

Nature of injury	No. of patients
Road Traffic Accidents	21
Assault	15
Fall	18
Sports injury	1
Total	55

Road Traffic Accidents and accidental fall constitute majority of cause of mandibular fractures. With increasing urban violence the incidence of assaults are also on the rise.

We found that on an average the patients reached the department about 10 hours after the injury.

Site-wise distribution of mandibular fractures is shown in the following

table

Table 4

Site-wise distribution of Mandibular Fractures

Site of fracture	No. of fractures
Dento-Alveolar	2
Symphyseal	3
Para-symphyseal	34
Body	7
Angle	31
Ramus	0
Condyle	5

Majority of fractures are seen in the angle and parasymphyseal region.

Nature of fracture is shown in the following table:

Table 5

Nature of Mandibular Fractures

Nature of fracture	No. of fractures
Single unilateral	29
Double unilateral	2
Bilateral	21
Sub condylar	3
Total	55

Single unilateral fractures are the most common type of fractures in this study. Among bilateral fractures the combination of one side parasymphyseal and another side angle fracture is the most common.

The types of alveolar canal in the injured patients as per their ortho pan tomogram study is as shown in the following table:

Table 6

Type of alveolar canal in patients with Mandibular Fractures

Type of Alveolar Canal	No. of Patients
Type – 1	4
Type – 2	48
Type – 3	2
Type – 4	1
Total	**55**

Majority of patients had their alveolar canal low down in the body. One patient had bifid alveoloar canal with left side angle fracture.

39 of the 55 patients were treated for mandibular fractures in this department. A patient with unicortical right side body fracture was observed without any intervention with dietary management and followed for a period of 2 months and was found to heal successfully. The following is the table which gives the details of management that was given to the patients.

Table 7

Management of Mandibular Fractures

Management option adopted	No. of patients
MAXILLO-MANDIBULAR FIXATION(MMF)	11
OPEN REDUCTION AND INTERNAL FIXATION WITH MMF	
Stainless steel wire	2
Miniplate and screws	9
Lag screw	0
OPEN REDUCTION AND INTERNAL FIXATION WITHOUT MMF	
Stainless steel wire	3
Miniplate and screws	10
Lag screw	1
ENDOSCOPIC GUIDED FIXATION	2

Majority of patients have been managed with open reduction and internal fixation with miniplate and screws, 21 of 38 patients(55%). Patients who had mandibulo-maxillary fixation were immobilized for 3-4 weeks and were adviced liquid and fluid diets for the period of immobilization.

Intra-oral approach was the preferred route for the management of all symphyseal, para-symphyseal and angle fractures, as it avoids external scar, provides better opportunity to achieve proper reduction and fixation and can be performed with experience in an easy manner.

Endoscopic guided fracture management of two cases of angle fracture was done using a 4mm 30 degree endoscope and using a sleeve technique for

fixation of fractures with a 0.5 mm external stab incision at the cheek. Accurate reduction and fixation was possible in these fractures, which are difficult to access through only an intra-oral incision.

Risdon and retro-mandibular incisions were carried out in 3 cases which had high angle fractures in the initial stages of the study. With progressing experience majority of the cases subsequently were managed with only intra-oral incision or Endoscopic guidance.

About 20 patients of the total number had associated injuries, 12 of which were major injuries and 6 minor injuries. 2 patients were on ventilatory treatment at the time of assessment and had not recovered. Patients who had Pan facial fractures were managed for the other fractures as well and hence some of them required maxillo-mandibular fixation.

Table 8

Patient with associated injuries

Nature of Injury	No.of Patients
Panfacial fractures	7
Upper Limb Injury	1
Lower Limb Injury	3
Head Injuries	2
Chest wall Injuries	2
Soft tissue Injuries face	5

All the patients who were managed were followed up for a period of 2 months to 2.5 years. The duration of hospital stay in these patients ranged from 2 days to 25 days, averaging 15days.

There were 4 complications noted among the patients treated with mandibular fractures during the study period. These include

1. A patient with impacted molar in the line of fixation which produced persistent pain which was managed with dental extraction

2. Marginal mandibular nerve paraesis was noted in a patient with right side angle fracture approached through sub mandibular incision, in whom a ORIF was done with miniplate and screw. The patient had not come for follow up after 2 months of improving paraesis.

3. A 23 year old female patient who had right parasymphyseal fracture who was managed with maxillary-mandibulo fixation(MMF) alone was found to have inter incisor distance of 1.5 cms after removal of MMF and was managed with dynamic mouth opening splint and had recovered full mouth opening in 2 months time.

4. One patient with left side angle and right side parasymphyseal fracture who was managed with MMF initially was found to have inadequate reduction of fracture and hence was managed with ORIF with miniplate

and screws and subsequently was found to have adequate reduction and fixation.

All the patients who were managed in this department during the study period for mandibular fractures were found to have good postoperative occlusion, adequate mouth opening and good reduction of fractures.

RESULTS OF THE STUDY

- 55 patients of Post-traumatic Mandibular Fractures were registered during the study period.
- Majority of the Mandibular Fractures were found to be in the 15 to 45 years age group, with predominance in 25-34 years age.
- Most of the Mandibular Fractures occurred in the Male
- Road Traffic Accidents were the most common cause of Mandibular Fractures.
- Most of the fractures occurred in the parasymphyseal region, when bilateral the combination of one side angle and other side parasymphyseal is the predominant variety.
- Single unilateral fractures were more common followed by bilateral fractures.
- On an average, patients reported to the department 10 hours after the injury
- Type – 2 Alveolar Canal was the most common variety in the study group
- About 39 of the 55 patients were treated in this department. In 11 patients closed technique(MMF) was adopted.

- In open technique of management, open reduction and internal fixation was done in 21 patients with Miniplate and Screws, SS-wire in 5patients and Lagscrew in 1 patient.
- Endoscopic guided fixation of Mandibular Fractures was done in 2 patients.
- There were 4 complications(10.2%) in the study group during the study period.

SUMMARY AND CONCLUSIONS

- At an average of 18 patients per year reporting to the plastic surgery department, Mandibular Fractures are gaining greater time and attention of the Plastic Surgeons.

- Investigations into the mechanism of trauma, along with careful physical examination will often identify the location of fracture, which can then be verified radiographically.

- With increasing vehicular traffic and urban violence, accidents and assaults are forming the majority of causes of Mandibular Fractures. Self disciplining of the individual and better policing might help to bring down the incidence.

- CT scan with 3D reconstruction and good Ortho Pantomogram has given us an accurate way of detecting even small fractures and their effects on the mandible and hence their management.

- The type of inferior alveolar canal identification helps in placing the mini plates along champy's lines and avoids damage to the nerve.

- With newer developments in the allied specilalities of medicine, patients with concomitant injuries can be managed efficiently, simultaneously treating the Mandibular Fractures.

- Intra-oral incisions, which avoids an external scar, have become the order of the day for almost all fractures of the mandible for it provides the necessary access and caters to the aesthetic expectations of the patient.

- Using mini plates and screws has significantly reduced the post-operative morbidity of the patient to a great extent, allowing for an early mobilization.

- With endoscopy pushing the frontiers of management of mandibular fractures, accurate reduction and stable fixation is definitely possible even in difficult fractures with minimal external scars.

BIBLIOGRAPHY

1. Gray, H. *Anatomy of the Human Body*, www.bartleby.com Ed. New York: Bartleby.com, 2000. P. 1247.

2. Lamphier, J., Ziccardi, V., Ruvo, A., et al. Complications of mandibular fractures in urban teaching center. *J. Oral Maxillofac.Surg.* 61: 745, 2003.

3. Ogundare, B. O., Bonnick, A., and Bayley, N. Pattern of mandibular fractures in an urban major trauma center. *J. Oral Maxillofac. Surg.* 61: 713, 2003.

4. Schweinfurth, J. M., and Koltai, P. J. Pediatric mandibular fractures. *Facial Plast. Surg.* 14: 31, 1998.

5. Sherick, D. G., Buchman, S. R., and Patel, P. P. Pediatric facial fractures: A demographic analysis outside an urban environment. *Ann. Plast. Surg.* 38: 578, 1997.

6. Hung, Y. C., Montazem, A., and Costello, M. A. The correlation between mandible fractures and loss of consciousness. *J. Oral Maxillofac. Surg.* 62: 938, 2004.

7. Chayra, G. A., Meador, L. R., and Laskin, D. M. Comparison of panoramic and standard radiographs in the diagnosis of mandibular fractures. *J. Oral Maxillofac. Surg.* 44: 677, 1986.

8. Wilson, I. F., Lokeh, A., Benjamin, C. I., et al. Prospective comparison of panoramic tomography (zonography) and helical computed tomography in the diagnosis and operative management of mandibular fractures. *Plast. Reconstr. Surg.* 107: 1369, 2001.

9. Bayles, S. W., Abramson, P. J., McMahon, S. J., et al. Mandibular fracture and associated cervical spine fracture, a rare and predictable injury: Protocol for cervical spine evaluation and review of 1382 cases. *Arch. Otolaryngol. Head Neck Surg.* 123: 1304, 1997.

10. Andrew, C. T., Gallucci, J. G., Brown, A. S., et al. Is routine cervical spine radiographic evaluation indicated in patients with mandibular fractures? *Am. Surg.* 58: 369, 1992.

11. Haug, R. H., Wible, R. T., Likavec, M. J., et al. Cervical spine fractures and maxillofacial trauma. *J. Oral Maxillofac. Surg.*49: 725, 1991.

12. Ardekian, L., Gaspar, R., Peled, M., et al. Incidence and type of cervical spine injuries associated with mandibular fractures. *J. Craniomaxillofac. Trauma* 3: 18, 1997.

13. Hemmings, K. W. Fracture of the cervical spine complicating bilateral fractures of the mandible: A case report. *Br. J. Oral Maxillofac. Surg.* 23: 279, 1985.

14. Donoff, R. B., and Roser, S. M. Management of condylar fractures in patients with cervical spine injury: Report of cases. *J. Oral Surg.* 31: 130, 1973.

15. Biller, J. A., Pletcher, S. D., Goldberg, A. N., et al. Complications and the time to repair of mandible fractures. *Laryngoscope* 115: 769, 2005.

16. Green, B. E., Jr. Use of modified head halter for a Barton bandage. *Plast. Reconstr. Surg.* 49: 466, 1972.

17. Schilli, W. Mandibular fractures. In J. Prein (Ed.), *Manual of Internal Fixation of the Craniofacial Skeleton.* Vol. 1, 1st Ed. New York:

Springer, 1998. Pp. 57-92.

18. Abubaker, A. O., and Rollert, M. K. Postoperative antibiotic prophylaxis in mandibular fractures: A preliminary randomized, double-blind, and placebo-controlled clinical study. *J. Oral Maxillofac. Surg.* 59: 1415, 2001.

19. Chidyllo, S. A., and Marschall, M. A. Teeth in the line of a mandible fracture: Which should be performed first, extraction or fixation? *Plast. Reconstr. Surg.* 90: 135, 1992.

20. Fuselier, J. C., Ellis, E. E., III, and Dodson, T. B. Do mandibular third molars alter the risk of angle fracture? *J. Oral Maxillofac. Surg.* 60: 514, 2002.

21. Dodson, T. B. Third molars may double the risk of an angle fracture of the mandible. *Evid. Based Dent.* 5: 78, 2004.

22. Wolujewicz, M. A. Fractures of the mandible involving the impacted third molar tooth: An analysis of 47 cases. *Br. J. Oral Surg.* 18: 125, 1980.

23. Villarreal, P. M., Monje, F., Junquera, L. M., et al. Mandibular condyle fractures: Determinants of treatment and outcome. *J. Oral Maxillofac. Surg.* 62: 155, 2004.

24. Ellis, E., III, Muniz, O., and Anand, K. Treatment considerations for comminuted mandibular fractures. *J. Oral Maxillofac. Surg.* 61: 861, 2003.

25. Schmidt, B. L., Kearns, G., Gordon, N., et al. A financial analysis of maxillomandibular fixation versus rigid internal fixation for treatment of

mandibular fractures. *J. Oral Maxillofac.Surg.* 58: 1206, 2000.

26. Smith, G. C., Moloney, F. B., and West, R. A. Mandibular advancement surgery: A study of the lower border wiring technique for osteosynthesis. *Oral Surg. Oral Med. Oral Pathol.*60: 467, 1985.

27. Booth, D. F. Control of the proximal segment by lower border wiring in the sagittal split osteotomy. *J. Maxillofac. Surg.*9: 126, 1981.

28. Lazow, S. K. The mandible fracture: A treatment protocol. *J.Craniomaxillofac. Trauma* 2: 24, 1996.

29. Alpert, B., Engelstad, M., and Kushner, G. M. Invited review: Small versus large plate fixation of mandibular fractures. *J. Craniomaxillofac. Trauma* 5: 33, 1999.

30. Forrest, C. R. Application of minimal-access techniques in lag screw fixation of fractures of the anterior mandible. *Plast.Reconstr. Surg.* 104: 2127, 1999.

31. Scolozzi, P., and Richter, M. Treatment of severe mandibular fractures using AO reconstruction plates. *J. Oral Maxillofac.Surg.* 61: 458, 2003.

32. Zide, M. F. Open reduction of mandibular condyle fractures: Indications and technique. *Clin. Plast. Surg.* 16: 69, 1989.

33. Haug, R. H., and Assael, L. A. Outcomes of open versus closed treatment of mandibular subcondylar fractures. *J. OralMaxillofac. Surg.* 59: 370, 2001.

34. Lindahl, L. Condylar fractures of the mandible: I. Classification and relation to age, occlusion, and concomitant injuries of teeth and teeth-supporting structures, and fractures of the mandibular body. *Int. J. Oral*

Surg. 6: 12, 1977.

35. Brandt, M. T., and Haug, R. H. Open versus closed reduction of adult mandibular condyle fractures: A review of the literature regarding the evolution of current thoughts on management. *J. Oral Maxillofac. Surg.* 61: 1324, 2003.

36. Oezmen, Y., Mischkowski, R. A., Lenzen, J., et al. MRI examination of the TMJ and functional results after conservative and surgical treatment of mandibular condyle fractures. *Int. J. Oral Maxillofac. Surg.* 27: 33, 1998.

37. Worsaae, N., and Thorn, J. J. Surgical versus nonsurgical treatment of unilateral dislocated low subcondylar fractures: A clinical study of 52 cases. *J. Oral Maxillofac. Surg.* 52: 353, 1994.

38. Ellis, E., III, and Throckmorton, G. Facial symmetry after closed and open treatment of fractures of the mandibular condylar process. *J. Oral Maxillofac. Surg.* 58: 719, 2000.

39. Throckmorton, G. S., and Ellis, E., III. Recovery of mandibular motion after closed and open treatment of unilateral mandibular condylar process fractures. *Int. J. Oral Maxillofac.Surg.* 29: 421, 2000.

40. Ellis, E., III, Palmieri, C., and Throckmorton, G. Further displacement of condylar process fractures after closed treatment. *J. Oral Maxillofac. Surg.* 57: 1307, 1999.

41. Ellis, E., III, Throckmorton, G. S., and Palmieri, C. Open treatment of condylar process fractures: Assessment of adequacy of repositioning and maintenance of stability. *J. OralMaxillofac. Surg.* 58: 27, 2000.

42. Ellis, E., III, McFadden, D., Simon, P., et al. Surgical complications with open treatment of mandibular condylar process fractures. *J. Oral Maxillofac. Surg.* 58: 950, 2000.

43. Assael, L. A. Open versus closed reduction of adult mandibular condyle fractures: An alternative interpretation of the evidence. *J. Oral Maxillofac. Surg.* 61: 1333, 2003.

44. MacLennan, W. D. Consideration of 180 cases of typical fractures of the mandibular condylar process. *Br. J. Plast. Surg.* 5: 122, 1952.

45. Silvennoinen, U., Iizuka, T., Oikarinen, K., et al. Analysis of possible factors leading to problems after nonsurgical treatment of condylar fractures. *J. Oral Maxillofac. Surg.* 52: 793, 1994.

46. Chuong, R., and Piper, M. A. Open reduction of condylar fractions of the mandible in conjunction with repair of discal injury: A preliminary report. *J. Oral Maxillofac. Surg.* 46: 257, 1988.

47. Lauer, G., and Schmelzeisen, R. Endoscope-assisted fixation of mandibular condylar process fractures. *J. Oral Maxillofac.Surg.* 57: 36, 1999.

48. Lee, C., Stiebel, M., and Young, D. M. Cranial nerve VII region of the traumatized facial skeleton: Optimizing fracture repair with the endoscope. *J. Trauma* 48: 423, 2000.

49. Sandler, N. A., Andreasen, K. H., and Johns, F. R. The use of endoscopy in the management of subcondylar fractures of the mandible: A cadaver study. *Oral Surg. Oral Med. OralPathol. Oral Radiol. Endod.* 88: 529, 1999.

50. Schon, R., and Schmelzeisen, R. Endoscopic fracture treatment. *Ann. R. Australas. Coll. Dent. Surg.* 16: 40, 2002.

51. Schon, R., Schramm, A., Gellrich, N. C., et al. Follow-up of condylar fractures of the mandible in 8 patients at 18 months after transoral endoscopic-assisted open treatment. *J. OralMaxillofac. Surg.* 61: 49, 2003.

52. Barber, H. D. Conservative management of the fractured atrophic edentulous mandible. *J. Oral Maxillofac. Surg.* 59: 789, 2001.

53. Marciani, R. D. Invasive management of the fractured atrophic edentulous mandible. *J. Oral Maxillofac. Surg.* 59: 792, 2001.

54. Luhr, H. G., Reidick, T., Merten, H. A. Results of treatment of fractures of the atrophic edentulous mandible by compression plating: A retrospective evaluation of 84 consecutive cases. *J. Oral Maxillofac. Surg.* 54: 250, 1996.

55. Yerit, K. C., Enislidis, G., Schopper, C., et al. Fixation of mandibular fractures with biodegradable plates and screws. *Oral Surg. Oral Med. Oral Pathol. Oral Radiol. Endod.* 94: 294, 2002.

56. Passeri, L. A., Ellis, E., III, and Sinn, D. P. Complications of nonrigid fixation of mandibular angle fractures. *J. Oral Maxillofac.Surg.* 51: 382, 1993.

57. Teenier, T. J., and Smith, B. R. Management of complications associated with mandible fracture treatment. *Atlas OralMaxillofac. Surg. Clin. North Am.* 5: 181, 1997.

58. Lois, D., Black, E., Atchison, K. et al. Complications of mandible

fractures: A comparison between maxillomandibular versus rigid fixation. *J. Oral Maxillofac. Surg.* 59 (Suppl. 1): 2001.

59. Collins, C., Lee, J., and Pirinjian, G. An analysis of 274 mandible fractures treated with monocortical fixation. *J. Oral Maxillofac. Surg.* 59: Supplement 1, 2001.

60. Maloney, P. L., Lincoln, R. E., and Coyne, C. P. A protocol for the management of compound mandibular fractures based on the time from injury to treatment. *J. Oral Maxillofac.Surg.* 59: 879, 2001.

61. Mathog, R. H. Nonunion of the mandible. *Otolaryngol. Clin. North Am.* 16: 533, 1983.

62. Mathog, R. H., and Boies, L. R., Jr. Nonunion of the mandible. *Laryngoscope* 86: 908, 1976.

PROFORMA FOR FRACTURES OF MANDIBLE

SERIAL NO.

NAME

AGE / SEX

ADDRESS

P.S. NO. / I.P. NO.

OCCUPATION

REFERRED BY

DATE OF INJURY

NATURE OF INJURY

INTERVAL BETWEEN INJURY AND ARRIVAL IN DEPARTMENT

GENERAL CONDITION OF PATIENT

CLINICAL FEATURES

A. SYMPTOMS

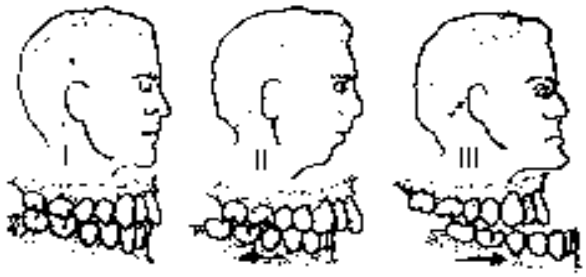
1. Swelling
2. Bleeding
3. Pain
4. Numbness along I.A.N
5. Loss of tooth/teeth
6. Altered bite
7. others

B. SIGNS

1. extra - oral – a. site of swelling/ laceration
b. bony contour deformity
cb. mouth opening
d. occlusion
e. bony tenderness
f. decreased sensation of lips
g. other symptoms

2. intra – oral - a. laceration of gingival/mucosa
b. ecchymosis
c. bony tenderness
d. crepitus
e. decreased sensation of teeth
f. occlusion - open bite – anterior / lateral
cross bite
retrusion
g. site of fracture
h.step deformity.
i.dental status
j. number of tooth posterior to fracture
k. other signs

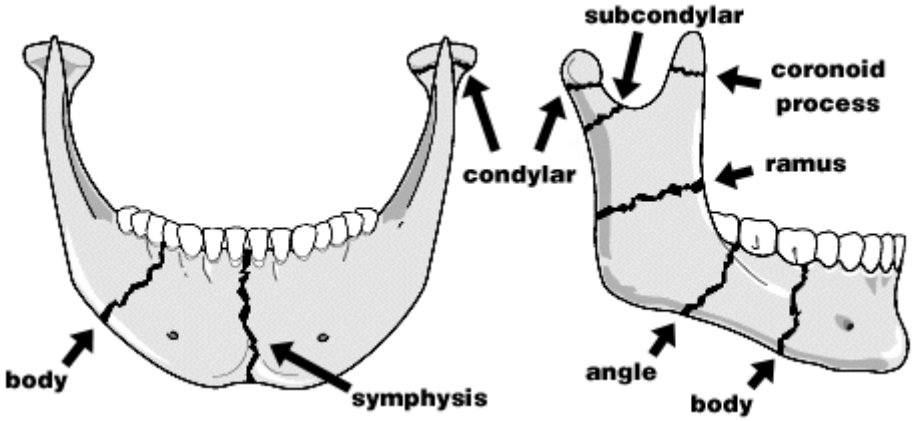
C. CLASS OF OCCLUSION



Angle Class I, II, and III Malocclusion

D. DENTAL STATUS

E. SITE/NUMBER OF FRACTURE



INVESTIGATIONS

BASELINE

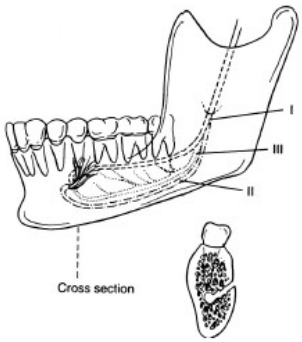
RADIOLOGY

A. X-RAYS

B. ORTHOPANTOMOGRAM

C. CT SCAN WITH 3D RECONSTRUCTION

D. STATUS OF INFERIOR ALVEOLAR CANAL



OTHER INJURIES / FRACTURES

MANAGEMENT

A. INITIAL TREATMENT

B. COMPREHENSIVE TREATMENT

NO TREATMENT

OPERATIVE

ARCH BARS

MANDIBULO-MAXILLARY FIXATION

ORIF WITH MMF

SS WIRE

MINIPLATE AND SCREWS

LAG SCREW

ORIF WITHOU MMF

SS WIRE

MINIPLATE AND SCREWS

LAG SCREW

ENDOSCOPIC GUIDED FIXATION

POSTOPERATIVE PERIOD

POSTOP OCCLUSION / FRACTURE REDUCTION

DURATION OF HOSPITAL STAY

PERIOD OF IMMOBILISATION

FEEDING PROTOCOL

COMPLICATION

FOLLOW -UP